In Situ Hydrating Polymer Coatings to Improve Chronic Performance of Neural Devices

Team 27: **Payton O'Connor, Riya Sen**
Advisor: **Tim O'Shea, Eric DuBois**

Neural implant devices, such as microprisms and electrodes, are powerful tools used for imaging, disease treatment, and pain management. However, these devices are often stiff compared to surrounding brain tissue and are prone to biofouling with adsorbed proteins, which leads to the initiation of a foreign body response (FBR), causing the premature failure of the implanted devices in vivo. In order to mitigate the unsolved problem of FBR and increase neural device lifetime, we developed a smart, bioactive, cellulose-based polymer coating that can transition its chemical and mechanical surface properties post implantation in response to reactive oxygen species (ROS) that are naturally generated around implant environments. Through the functionalization of hydroxyethyl cellulose (HEC) with 3-(methylthio)-propyl isothiocyanate (MTPI), we synthesized a hydrophobic polymer and optimized dip coating parameters for coating implant surfaces using a solvent system of acetone and dimethyl sulfoxide. We achieved controllable coating thickness and material deposition on a glass substrate through the variation of solvent system, composition, dipping speed, and temperature. When exposed to physiologically relevant concentrations of ROS in vitro, we detected oxidation of thiol ethers on the HEC-MTP polymer to sulfoxides (HEC-SO) that resulted in an increase in hydrophilicity and emergent, non-fouling material properties. Through the optimization of HEC-MTP coatings and coating protocol achieved through this project, we will enable increased quality of data collection and treatment effectiveness for patients suffering from neurodegenerative diseases.